

TRMM Version 8 Level 1C Release Notes

Tropical Rainfall Measuring Mission (TRMM) Version 8 (V8) fully incorporates TRMM data into Global Precipitation Measurement (GPM) data processing. TRMM and constellation products become part of the GPM data suite. Products are all in GPM HDF5 format and are labeled with product version V05.

1. TRMM V8 Level 1C TRMM Microwave Imager (TMI) brightness temperature (T_c) differs from TRMM V7 by as much as 2.3 K for some channels (see Figure 1) due to the following changes:

A. Improvements implemented in the V8 TMI L1B/1Base level:

- Adjusted TMI APC. This adjustment is the major improvement from V7 to V8 in TMI antenna pattern correction. The adjustment is based on the data from TMI deep space and other special calibration maneuvers, and refinements of the analysis from the GPM Intercalibration Working Group (X-CAL).
- Added TMI emissive antenna correction to replace the V7 empirical warm correction. The adjustment is based on reflector emissivities as a function of frequency derived using the data from TMI deep space and other special calibration maneuvers, derived reflector physical temperatures, and refinements of the analysis from the X-CAL team.
- Used multiple scan calibration averaging to replace the V7 single scan calibration.
- Added correction on warm intrusions (Moon and RFI) onto cold load and Sun intrusions onto the hot load.
- Updates to the TRMM spacecraft attitude.
- Updated view-angle offsets for the TMI feedhorns based on geolocation analysis for more accurate pointing information by channel.
- Updated the cross-scan bias corrections to account for scene temperature dependent differences based on an analysis over both cold (ocean) and warm (land) scenes.

- B. In addition to the L1B/1Base level T_b changes, TRMM V8 Level 1C TMI brightness temperature (T_c) has been intercalibrated to be consistent with the V05 GPM Microwave Imager (GMI) brightness temperature. The V7 TMI T_c had no intercalibration applied.

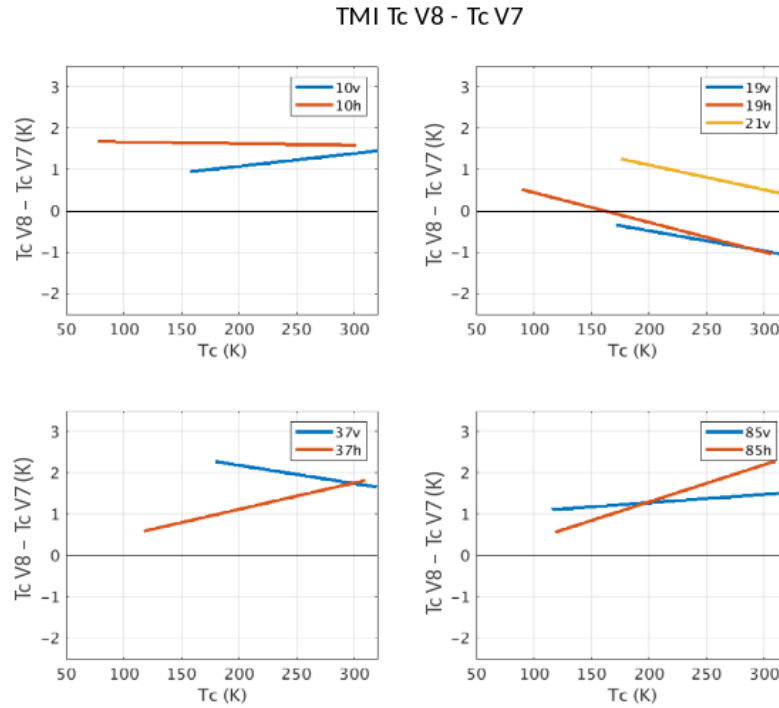


Figure 1. TMI L1C Mean Tc Differences Between V8 and V7 (January 2014)

2. TRMM V8 Level 1C TMI brightness temperature (also known as GPM V05 Tc) differs from GPM V04 1C TMI Tc by as much as 1.2 K at the cold end and -1.6 K at the warm end for some channels (see Figure 2) due to the following changes:
 - A. Same improvements as described in 1.A.
 - B. TRMM V8 (or GPM V05) TMI Tc has been intercalibrated to be consistent with the V05 GMI brightness temperature, while GPM V04 TMI Tc was intercalibrated to V04 GPM GMI brightness temperature.

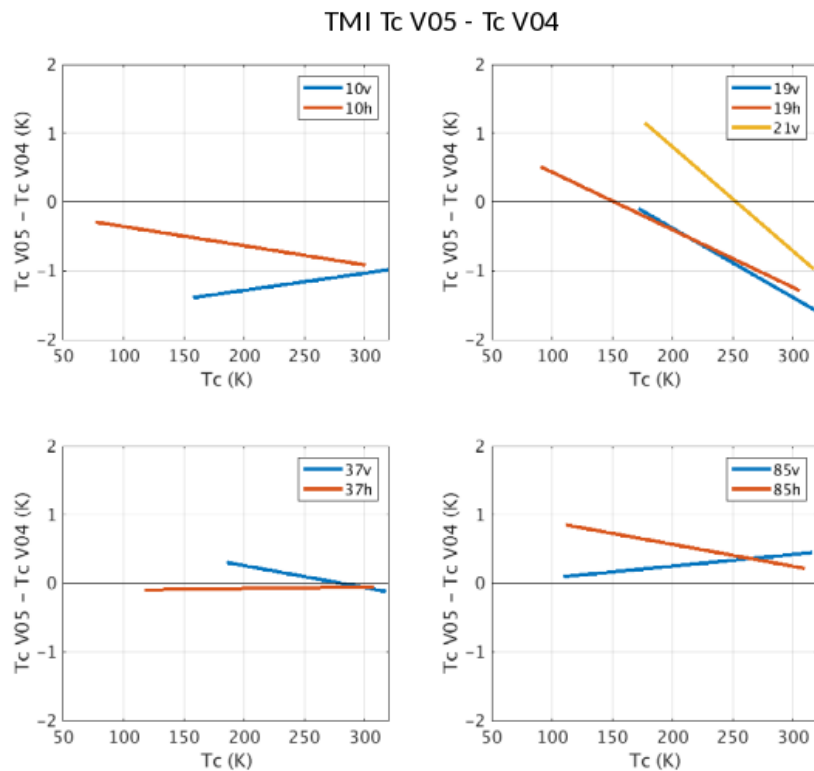
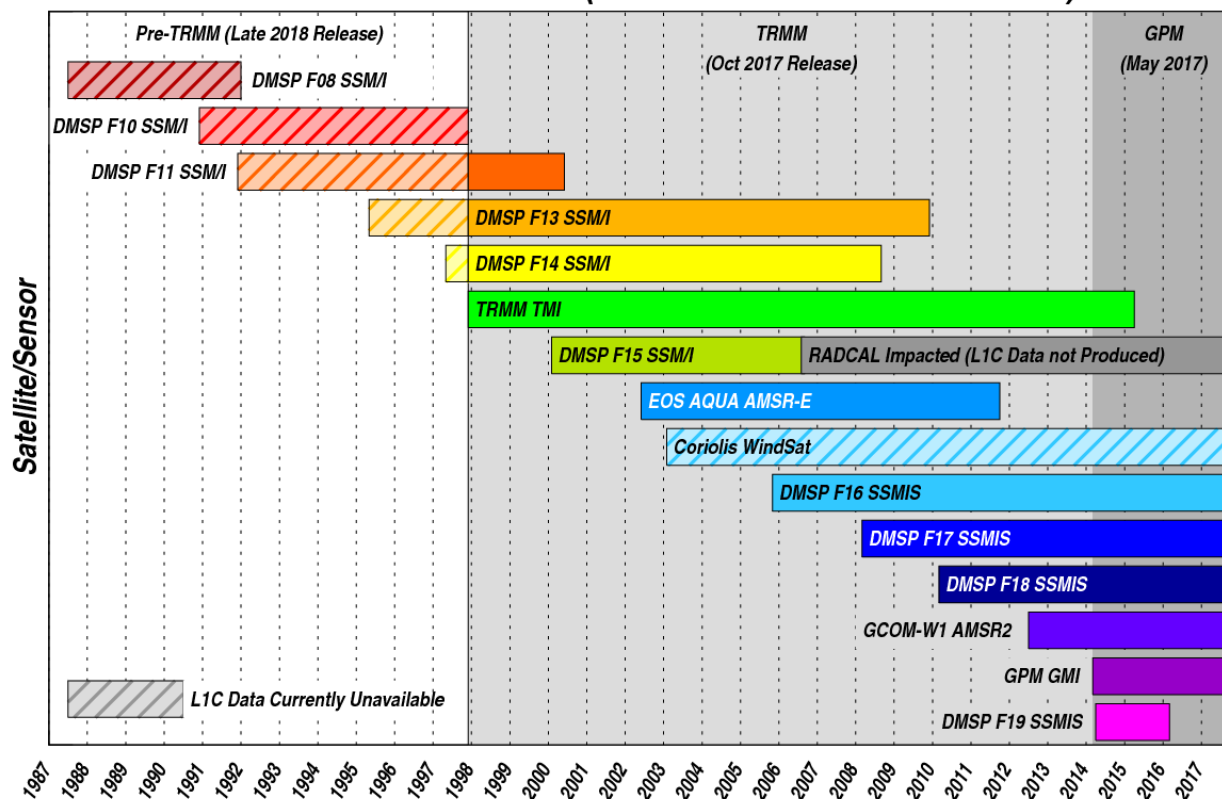


Figure 2. TMI L1C Mean Tc Differences Between V05 and V04 (March 2014)

- For all partner radiometers, the Level 1C brightness temperature (T_c) data has been intercalibrated to be consistent with the V05 GMI brightness temperature. See Figure 3 for TRMM constellation data availability.

Intercalibrated Level 1C (Window Channel Radiometers)



Intercalibrated Level 1C (Cross-Track Sounding Radiometers)

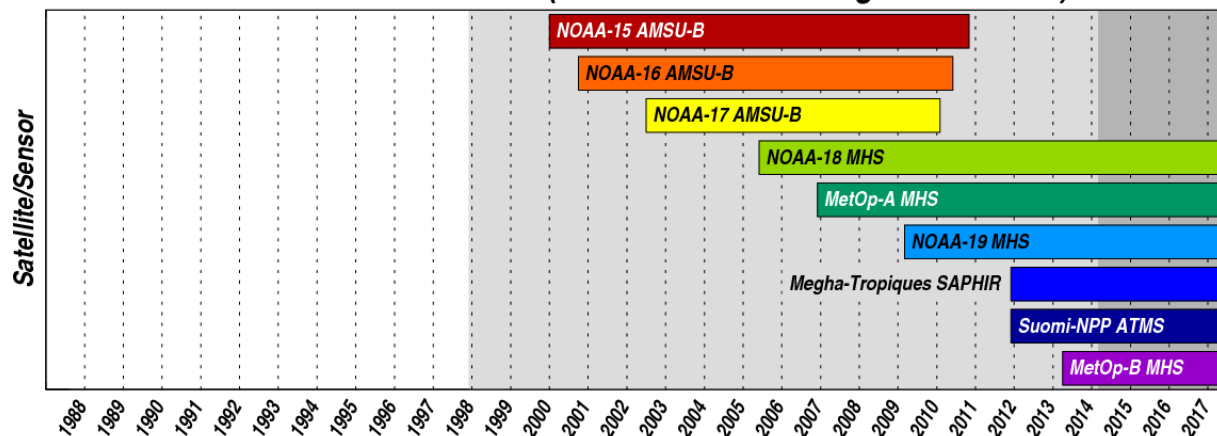


Figure 3. Level 1C Data Availability for Version 8 TRMM Constellation

4. Based on the X-CAL team’s recommendation, some data has been flagged as “bad” or “caution” in the Level 1C product due to poor data quality, sensor issues or failure. A detailed report on the Advanced Microwave Sounding Unit – B (AMSU-B) data quality from the X-CAL team is attached (Appendix A).

Sensor	Channel	Start Date (Orbit)	End Date (Orbit)	Flag	L1C Tc
SSMIS F16	150 H	20150501 (59504)	20150826 (61160)	Bad	Set to missing
	183+/-1 H	20131201 (52214)	20150826 (61160)	Bad	Set to missing
	183+/-3 H	20131201 (52214)	20150826 (61160)	Bad	Set to missing
	183+/-7 H	20131201 (52214)	20150826 (61160)	Bad	Set to missing
	91 V	20150424 (59413)	20150826 (61160)	Caution	
	91 H	20150424 (59413)	Ongoing	Caution	
SSMIS F17	37 V	20160405 (48595)	20160518 (49201)	Bad	Set to missing
	37V	20160803 (50286)	Ongoing	Bad	Set to missing
SSMIS F18	150 H	20120214 (11988)	Ongoing	Bad	Set to missing
AMSU-B NOAA-15	89	20090101 (55297)	End of mission	Bad	Set to missing
	183+/-1	20090101 (55297)	End of mission	Bad	Set to missing
	183+/-3	Begin	End of mission	Bad	Set to missing
	183+/-7	20090101 (55297)	End of mission	Bad	Set to missing
AMSU-B NOAA-16	183+/-1	20080101 (37503)	End of mission	Bad	Set to missing
	183+/-3	20080101 (37503)	End of mission	Bad	Set to missing
	183+/-7	20080101 (37503)	End of mission	Bad	Set to missing
AMSRE AQUA	89 A V+H	20041104 (13322)	End of mission	Bad	Set to missing

Appendix A

AMSU-B V05 Level 1C Release Notes (July 31, 2017)

The Advanced Microwave Sounding Unit-B (AMSU-B) is a cross-track scanning humidity profiler with channels near the 183 GHz water vapor line that flew on board the NOAA-15, -16, and -17 polar-orbiting spacecraft. Coincident observations were compared between the various AMSU-B sensors (Version TRMM005) and the Microwave Humidity Sounders (MHS) on NOAA-18 and MetOp-A. The MHS brightness temperatures (Tb) were recalibrated to GPM GMI (V05), which was adopted by the X-CAL team as the calibration standard for all the radiometers in the TRMM/GPM radiometer constellation.

Data Quality: The performance of the AMSU-B instruments on board both NOAA-15 and -16 was generally very poor, while the data from the NOAA-17 AMSU-B was quite good. Intercalibration offsets are applied to the Tb for the data range indicated by the green bars “good” in Figure 1, with the Tb corresponding to channels indicated by the red bars “bad” set to missing. Even within the “good” range, however, the data should be used with caution as there are variations in the calibration and biases across the scan that vary over time. The 183 ± 3 GHz channel on NOAA-15 was especially problematic and has thus been set to missing over the entire data record. We do not consider this channel to be useful for any application. Both NOAA-15 and -16 also had severe degradation starting in 2008 for several of the NOAA-16 channels and in 2009 for several of the NOAA-15 channels (see Figure 2).

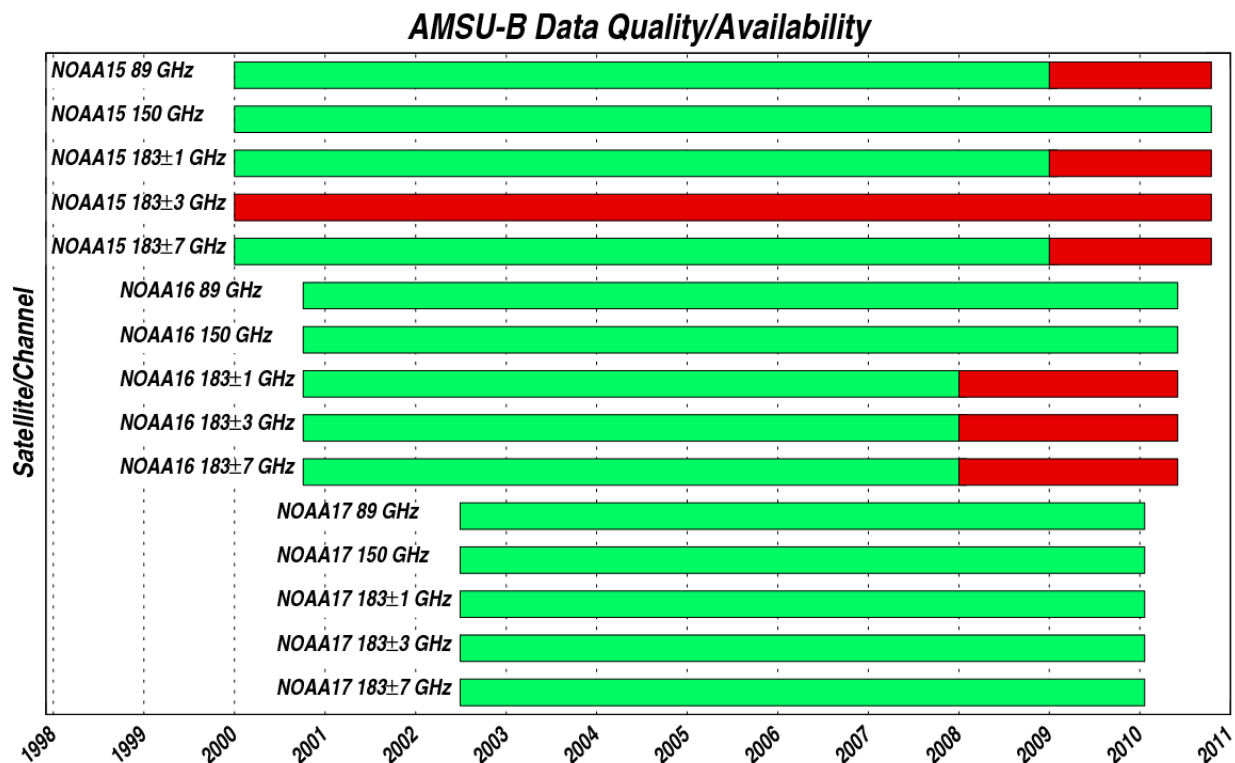


Figure 1: Data availability by channel for the AMSU-B instruments on board NOAA-15, -16 and -17. Green indicates data is useable, while red indicates that the data for a given channel has been flagged as bad and set to missing in the Level 1C data files.

NOAA-15 AMSU-B

89.0 GHz	Useable through December 2008
150 GHz	Useable over entire data record
183±1 GHz	Useable through December 2008
183±3 GHz	Not useable over entire data record
183±7 GHz	Useable through December 2008

NOAA-16 AMSU-B

89.0 GHz	Useable over entire data record
150 GHz	Useable over entire data record
183±1 GHz	Useable through December 2007
183±3 GHz	Useable through December 2007
183±7 GHz	Useable through December 2007

NOAA-17 AMSU-B

89.0 GHz	Useable over entire data record
150 GHz	Useable over entire data record
183±1 GHz	Useable over entire data record
183±3 GHz	Useable over entire data record
183±7 GHz	Useable over entire data record

Time series of simulated minus observed Tb for the 183 GHz channels are shown in Figure 2 below for the AMSU-B instruments on board NOAA-15, -16 and -17 as well as the four MHS instruments on board NOAA-18 and -19 and MetOp-A and -B. This figure clearly shows the substantial degradation in the calibration in the NOAA-15 and -16 channels, as well as the variability in the 183±3 GHz channel for AMSU-B on board NOAA-15. Note that these are average differences, although the standard deviation in the single difference values also increases dramatically for NOAA-15 and -16 resulting in much larger instantaneous calibration errors that can have significant impacts on precipitation and other geophysical parameter retrievals.

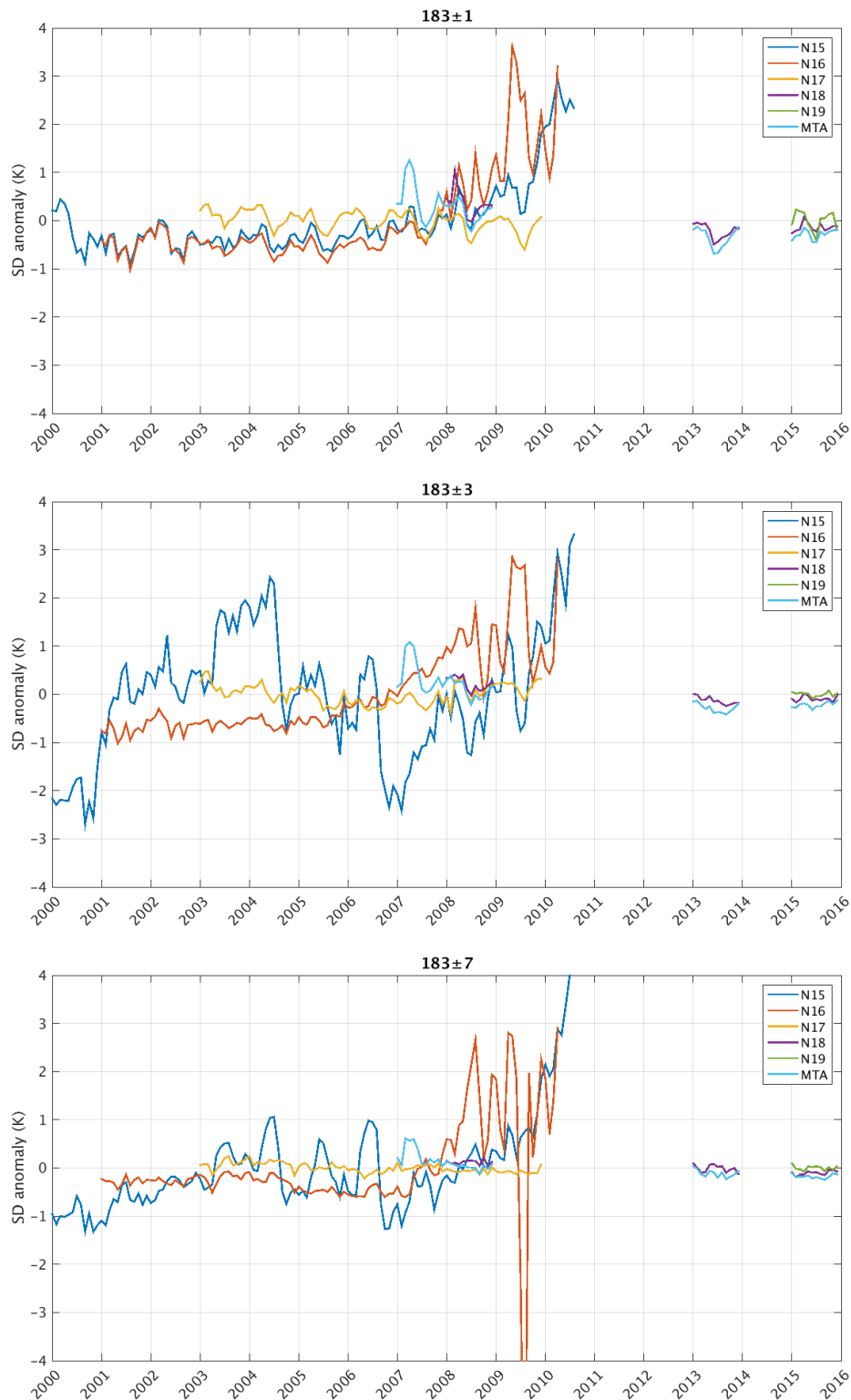


Figure 2: Time series of single differences (Observed – Simulated Tb) for the 183 GHz channels of the TRMM/GPM cross-track sounders. These plots and the associated analysis were produced by Rachael Kroodsma at NASA’s Goddard Space Flight Center.